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U. S. DEPARTMENT OF
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FARMERS' BULLETIN No. 1300

CHOOSING
A TRACTOR



The following series of six bulletins has been prepared under the direction of the committee on farm power, appointed by the Secretary of Agriculture to represent the Bureau of Agricultural Economics, Bureau of Public Roads, and Bureau of Animal Industry in a cooperative study of all phases of the farm power problem:

Farmers' Bulletin 1295: What Tractors and Horses Do on Corn-Belt Farms.

Farmers' Bulletin 1296: Changes Effected by Tractors on Corn-Belt Farms.

Farmers' Bulletin 1297: Cost of Using Tractors on Corn-Belt Farms.

Farmers' Bulletin 1298: Cost of Using Horses on Corn-Belt Farms.

Farmers' Bulletin 1299: Shall I Buy a Tractor (For a Corn-Belt Farm)?

Farmers' Bulletin 1300: -Choosing a Tractor (For a Corn-Belt Farm).

This bulletin, which is No. 6 of the series, is for the farmer who has decided to purchase a tractor, and is designed to aid him in the proper choice of a machine which will be suitable to his conditions and needs.

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CHOOSING A TRACTOR (FOR A CORN-BELT FARM).

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MANY A CORN-BELT FARMER, after making up his mind to buy a tractor, is just as much at a loss in trying to decide on the particular size, type, and make of machine to buy as he was in deciding whether to buy or not.

Various and often conflicting statements regarding the particular merits of each make of tractor are set forth in tractor catalogues and by dealers. The claims and counter claims of what this or that particular machine will do are more often confusing than enlightening to the prospective purchaser. It is the intention of every farmer who buys a machine to get one that will prove a profitable investment, that will do its work efficiently and always be dependable. If the machine finally bought fulfills these expectations, the farmer considers it a success; if it proves inefficient and unreliable, through no fault of his own, he feels that the tractor for farm use is a failure.

This bulletin, based largely on the experience of tractor owners, is written to aid the Corn-Belt farmer in choosing the size of tractor best suited to his farm and the work there is for it to do and the type of machine to get for use under various conditions and to point out the conveniences to look for and the importance and value of service.

SIZE OF TRACTOR.

One of the most difficult questions which the prospective tractor owner has to decide in purchasing a machine is that of the proper size which will be best suited to his needs. Many of the early tractor owners purchased machines which they later found to be unsuitable for use on their farms.

The earlier machines were unquestionably too large for many of the farms upon which they were owned. However, as the possibilities of tractors were realized smaller machines were built, so that it is now possible to purchase a tractor of a size suited to the farm and the work there is to do.

Information obtained by the United States Department of Agriculture in 1920 from several hundred tractor owners in the Corn-Belt States, who had previously furnished information on their machines in 1917 and 1918, showed that of 348 men who had purchased new tractors 195, or 56 per cent, had purchased the same size as their old machine; 82, or 24 per cent, had purchased smaller machines, and 70, or 20 per cent, had purchased larger. From the above it would seem that many of these men had found the first tractor unsuited to the needs of their farms.

Information obtained from 608 tractor owners in Illinois in 1917 and 1918 showed that the average size of farm on which 2-plow machines were used was 180 acres, 3-plow machines 250 acres, and 4-plow machines 300 acres. The average minimum size of farm upon which these same men thought that a tractor the size of theirs would be used profitably was 130 acres for the 2-plow, 170 acres for the 3-plow, and 210 acres for the 4-plow.

Table 1 shows the number of tractors of different sizes on farms of different sizes (as measured by number of crop acres). This information was obtained in Ohio, Indiana, and Illinois in 1920.¹ Seventy-five per cent of the farms with less than 160 crop acres were equipped with 2-plow tractors, and 53 per cent of those with 160 or more crop acres were equipped with this size of machine. (Fig. 1.)

TABLE 1.—*Number of tractors of different sizes on farms of different sizes.*

Size of farms (crop acres).	Number of farms.	1-plow tractor.	2-plow tractors.	3-plow tractors.	4-plow tractors.	5-plow tractor.
Less than 80.....	7	.....	5	2	.....	.....
80 to 119.....	28	1	22	5	.....	.....
120 to 159.....	71	.....	52	19	.....	.....
160 to 199.....	56	.....	29	26	1	.....
200 to 239.....	47	.....	27	18	2	.....
240 to 279.....	36	.....	18	18	.....	.....
280 to 319.....	19	.....	10	9	.....	.....
320 or more.....	22	.....	11	7	3	1
Total.....	286	1	174	104	6	1

There is no rule that will automatically show the size of tractor to buy for a farm of a given size. In deciding on the horsepower of the machine, experience should be the most valuable guide. This, of course, is something that the man who has never had a tractor lacks. The experience and recommendations of Corn-Belt farmers who have owned and operated tractors should, however, prove of value in giving an approximate indication of the most suitable sizes for different-sized farms.

It is perhaps the common idea that the size of the tractor will govern the number of work stock disposed of. From the experience of the men interviewed in 1920 this does not seem to be true. There were 172 men who had not changed the size of their farms. Of this number, 107 owned 2-plow and 61 owned 3-plow machines. Before the purchase of tractors the owners of each size had kept one horse for each 21.7 crop acres. When the investigation was made the owners of the 2-plow machines had one head for each 28.9 crop

¹ U. S. Department of Agriculture, Bulletin 997, p. 12.

acres and the owners of the 3-plow machines one for each 29.6 crop acres. (Fig. 2.) On the average, the owners of each size had reduced their work stock by 2.2 head.

The kind of soil, topography, surface conditions, and the use to be made of a tractor will influence choice as to horsepower. All manufacturers state the number of plows that their tractor will pull under ordinary conditions. However, a tractor capable of pulling three plows in one field may be able to pull only two in another, owing to heavy soil, rough topography, or adverse surface conditions. When it is the intention to do all of the plowing and most of the ground preparation prior to planting, it may be necessary to get a machine of greater horsepower than would suffice if horses were to be used for a part of this work. Again, where the operations to be performed vary in the amount of power required,

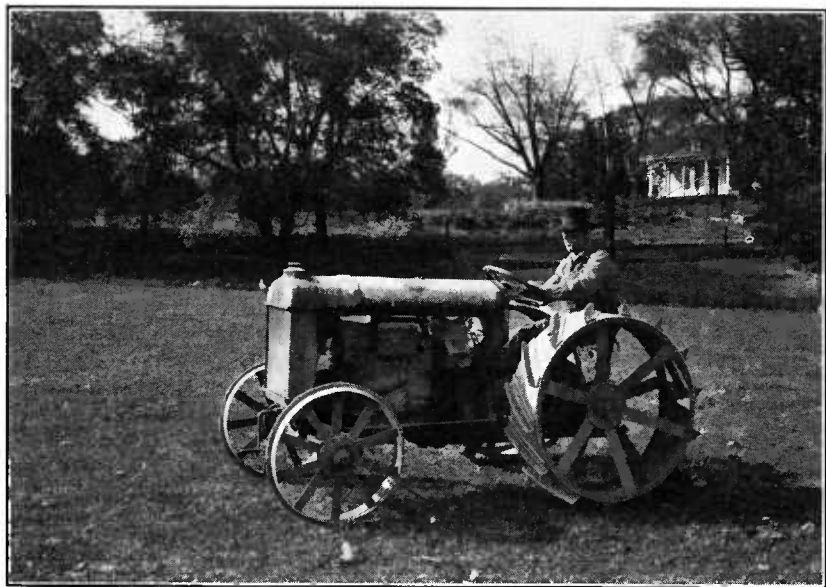


FIG. 1.—Two-plow wheeled tractors are used more commonly than any other type in the Corn Belt.

the horsepower may have to be greater than otherwise would be desirable in order that there may be sufficient reserve power to take care of any extra heavy work which may have to be done.

If it is the intention to use the machine more for belt work than on the drawbar, it will sometimes be necessary to get a machine of greater horsepower than ordinarily would be needed. Where a tractor of a certain horsepower is capable of doing the necessary drawbar work it may not be powerful enough to do all of the belt work desired.

When only light belt work is to be done, such as grinding feed and sawing wood, the power needed for drawbar operations will be the more important. For such operations as thrashing, silo filling, shelling, and shredding and husking, more power is needed than for any other common belt operation. In deciding upon a tractor the

belt horsepower required to run the largest machine which will be used with any regularity should first be determined. This can easily be done, as the manufacturers always give the range of horsepower necessary to operate their machines. However, considerable variation will be found in the power recommended by the different manufacturers for machines of the same size.

There may be tractors in the neighborhood on farms of varying sizes, and it will always be well to observe the results accomplished by these different machines before determining the probable size best suited for the home farm. The recommendations of neighbor owners will, no doubt, be of great assistance not only as to size but on all other points as well, and by their experience the prospective purchaser will be able to choose more wisely than if he were to go ahead blindly. The various sizes have their advantages and disadvantages,



FIG. 2.—Three-plow wheeled tractors are in use on many Corn-Belt farms.

and when these have all been weighed and considered, the size best suited for the particular farm can be decided upon.

For plowing there is little advantage, as far as saving time is concerned, in the use of a 1-plow outfit. However, some drawbar work, such as disking and harvesting, may be done advantageously with this size of machine, and the horses relieved from the hard work of disking and the heat of the harvest season. This size can be used to advantage for belt work of a light character, if there is such work to be done and a stationary engine is not available.

Two and three-plow machines are used on the majority of Corn-Belt farms where tractors are owned. Information obtained in Illinois, Indiana, and Ohio in 1920¹ showed that on 286 farms in these States there were one hundred and seventy-four 2-plow and one hundred and four 3-plow tractors and only eight of all other sizes. It

¹ U. S. Department of Agriculture, Bulletin 997, p. 9.

would seem that, for these Corn-Belt men at least, the 2-plow and 3-plow sizes are more satisfactory than any other size.

With a tractor it will be possible to do all of the plowing and prepare all of the land for planting without the use of horses. Thirty-four of the above-cited men who operated 2-plow outfits did all of this work with their machines. Loading hay and harvesting are also operations for which this sized outfit is sometimes used. The ordinary 4-wheeled tractor is not suitable for cultivating corn, but the general-purpose machine will be found satisfactory for this work. For use on the belt the 2-plow size will do the work ordinarily required on the farm, and may also be available for some custom work.

The 3-plow outfits naturally are capable of a greater amount of work per day on all operations than are the 2-plow machines. However, owing to the greater weight of the 3-plow machines they are not used as commonly on plowed ground, because they sometimes pack the soil injuriously. Of the 104 Corn-Belt farmers mentioned above who owned 3-plow outfits, only 5 did all of their plowing and preparing ground prior to planting with their tractors. Where the belt work requires more power, especially when it is custom work, the 3-plow size will be found more practicable, as there is more reserve power available.

On few farms in the Corn Belt will it be found desirable to buy 4-plow or larger machines. Where the acreage is very large, and also the fields, it may prove economical to buy such machines. Four-plow and larger outfits naturally cover more ground in a given time, but they are harder to handle than the smaller outfits. Turning at the end of the field will require more room than with the smaller tractors. It will often be necessary to finish the corners with horses. In using these larger machines on light operations there will frequently be a wastage of power.

TYPE OF TRACTOR

The type of tractor to choose for use in the Corn Belt will be governed largely by the personal desires of the operator, though in some localities the type that should be chosen, as well as the size, will be governed to a certain extent by the soil, topography, surface conditions, and use to be made of the tractor. In considering the choice of a machine there will be three principal types to choose from, namely, the ordinary wheeled tractor (Figs. 1 and 2), the crawler (Fig. 3), and the general-purpose machine (Fig. 4). To some extent the type may affect the number of horses it will be possible to displace.

The weight of the different types varies considerable for different horsepower and even for the same horsepower. When soil conditions are unusual, and where there is danger of packing, the question of weight should be given careful consideration. It should not be overlooked, however, that, in general, the lighter the machine the less sturdy it is.

The ordinary wheeled tractor is in more common use than any other. Under usual soil conditions, such as are found in the Corn Belt, the wheeled tractor will perform efficiently. All tractors of this type now have four wheels. A few years ago a number of tractors were manufactured with three wheels, two drive wheels and

one guide wheel. Owing to greater difficulty in handling, especially in turning on soft ground, these models have been discarded, as it was realized that the four-wheeled machines were more practical.

Some machines, especially 2-plov, are so designed that one driver runs in the furrow in plowing, while with others all four wheels are on the unplowed land. On land where the soil breaks down easily or is soft, machines of this latter type tend to slip into the furrow, owing to the side wall giving away. Under ordinary conditions no injury will result to the soil where one drive wheel runs in the furrow.



FIG. 3.—The crawler tractor can be used on some soils not suitable for the wheeled tractor.

The crawler tractor runs on an endless track, the purpose being to distribute the load over a greater area, increase traction, and reduce packing of the soil as compared with the wheeled type. In sandy areas this type of machine will travel when the wheeled tractor will often stall or dig in when pulling a load. The same advantage is gained where there are some spots in the fields, owing to excessive moisture. The first cost and the upkeep for the crawler type is greater than for the wheeled tractor of the same power. Where the soil contains sand and grit the tracks, unless made of the highest-class material, wear rapidly and have to be replaced at intervals.

The general-purpose tractor is designed to perform some jobs in addition to those ordinarily done, and for which other types are not suited. In addition to the ordinary work of plowing, disking, harrowing, and harvesting, these tractors may be used for planting and cultivating corn, especially the latter. If a tractor does the plowing and harrowing, the horse-labor peak load is shifted to the period of corn cultivation. If, now, the tractor is able to do also all or a part of this work, either considerable time will be saved, unless it has been the practice to use 2-row horse-drawn cultivators, or the corn can be cultivated more frequently. In either case more horses can be disposed of than with either of the other types. (Fig. 4.)

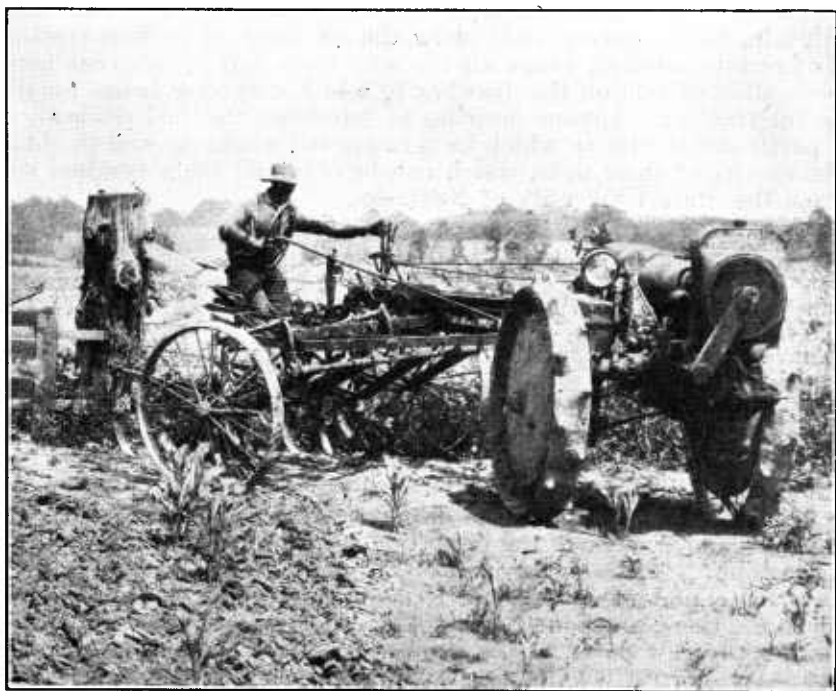


FIG. 4.—The general-purpose tractor is adaptable for cultivating corn.

FUEL.

All of the earlier machines were made to burn gasoline. Of late years, owing to the high cost of gasoline, many machines have been placed upon the market which burn kerosene. There are also some which will burn either fuel, and others which burn distillate. Kerosene and distillate, while burned efficiently by the tractors which use them, do not burn so satisfactorily as gasoline. However, no great trouble need be expected with a machine burning these low-grade fuels. In past years, when kerosene was first being used as a fuel, some difficulty was experienced, but, with the development of a carburetor capable of handling the lower grades of fuel, little difficulty is now experienced.

Results obtained by farmers show that when a tractor is pulling its normal load the amount of fuel per unit of work done does not vary appreciably for the different sizes. The amount of fuel consumed will depend to a certain extent on the proficiency of the operator. The experienced tractor owner will be able to run his machine on less fuel than the new or inefficient owner. Likewise, varying soil conditions on different farms affect the amount used. It is sometimes stated that where kerosene is used as a fuel the oil in the crank case becomes thin, owing to unburnt kerosene occasionally escaping past the piston rings. With proper carburetor adjustment little trouble should be experienced from this source, provided, of course, all cylinders are firing and the piston rings are tight.

The Nebraska State tests, as conducted at the State University, Lincoln, Nebr., during 1920, show the efficiency of various tractors. The results obtained range all the way from 6.57 horsepower hours per gallon of fuel on the drawbar to 2.45 horsepower hours for different tractors. Anyone desiring to determine the fuel efficiency of a particular tractor in which he is interested would do well to obtain the results of these tests, which can be obtained for a nominal sum from the State University of Nebraska.

RELIABILITY.

Any standard tractor will ordinarily be found reliable. This feature is one in which the prospective purchaser should be vitally interested, for upon reliability the value of the tractor as a source of power depends.

It is natural to suppose that any machine will be out of commission at some time or other. However, this time out of commission must not be long enough to cause a serious delay and necessitate the purchase of additional horses in a busy season.

Service.—The ability of the dealer to render prompt and efficient service should be one of the important points to consider in choosing a machine. Service and a competent operator in most cases are the keys to reliability. If service is lacking, no matter how good the machine, there are bound to be costly delays. If the local dealer can supply new parts, and is equipped to do the repair work when necessary, no costly waits need be expected when repairs are needed.

A good tractor, with poor service, may be worse than a poor tractor with good service. If the local dealer has no repairs in stock, or only very few, the tractor can not be relied on to furnish continuous power. An ordinary break in a busy season may result in a long wait while repairs are sent for, with the result that some operation is seriously delayed. Also, if there is no local dealer, and it is necessary to send to the factory or a branch house for repairs, costly delays will ensue.

Some men are so located that the factory is close at hand. All that is necessary for them to do in case of breakage is to go to the plant and get the parts needed, little loss of time being entailed. Many operators have purchased a certain machine because of this advantage.

The time lost owing to breakage is directly dependent upon the kind of service the dealer gives. Some small breaks, of course, may be mended in the local blacksmith shop. And, no matter how good

the service, there may be now and then a breakdown so serious that some time may be lost.

ACCESSIBILITY.

The ease with which it is possible to reach and adjust or replace any vital part of the tractor is a feature that should be considered before deciding upon any machine. However, accessibility and sturdy construction do not always go together.

Those parts of the engine which should be easily accessible are the crank shaft and bearings, connecting rods and bearings, pistons, and valves. There is considerable difference among the various makes in the ease with which the cylinder head can be removed. The transmission gears should be easy to inspect and adjust. Easily reached fuel and water tanks large enough to hold an all-day's supply are desirable.

The complete inclosure of all working parts prevents undue wear from dust and grit. This often results in less accessibility, but the saving effected in upkeep and cost of repairs may offset any inconvenience due to lack of accessibility.

With the motor, which on most machines has four cylinders, placed so that the crank shaft is at right angles to the rear axle, accessibility is usually better than when it is placed so that the crank shaft is parallel to the rear axle. In the first instance, bevel or worm gears are necessary to transmit the power to the drive wheels and to the belt. This, of course, means some loss of power and extra wearing parts. In the second instance, the power is transmitted without the use of bevel gears and the belt pulley is generally attached directly to the shaft of the engine.

The position of the belt pulley should not be overlooked, as it is sometimes put in a very inconvenient place, and sometimes where it may endanger the operator. On most machines the pulley is on the side so that the tractor faces the driven machine and can be backed into the belt when connected up. When the pulley is on the front of the machine more difficulty will be experienced in getting the machine into position to get the proper tension on the belt, as it will have to be run up at a right angle to the driven machine to connect up with the belt.

ACCESSORIES AND EXTRA EQUIPMENT.

Many tractors come supplied with extra equipment of a more or less important nature which naturally is added to the first cost of the machine. However, it is possible to purchase any of this equipment for machines which do not come already supplied.

Wheeled tractors are supplied with lugs or cleats to give extra traction. When the soil is soft and extra bearing surface is wanted for the machine, the extension rims will be found a valuable addition. These can readily be attached or detached from the drive wheels as desired.

A furrow-guide will be found a valuable piece of equipment for a machine which runs with all wheels on the unplowed land.

Some tractors come equipped with lights. This permits night work to be done, which is sometimes desirable. Tractors not so equip-

ped may be fitted up for night use by the purchase of the necessary equipment.

Every tractor should have an efficient air-cleaning device. At the present time most tractors have air cleaners or washers, a device for removing the dust from the air before it reaches the carburetor and is taken into the engine. The dirt brought up by the wheels often envelopes the tractor in a cloud of dust. The dust-laden air is sucked into the cylinders and unless this is prevented the pistons and cylinders are soon ruined and a heavy expense will result. There are several types of strainers which give satisfactory results if given proper attention.

Practically every tractor now comes equipped with a governor, especially for belt work. The purpose of this piece of equipment is to maintain a uniform speed for different loads. If the tractor does not have a governor, it will do more satisfactory work if a good one is installed.

Frequently the complaint is heard that on some tractor operations more men are required than when the work is done with horses. To do away with this difficulty many manufacturers have equipped their machines or made them in such a manner that extended controls can be used. By the use of such controls one man can operate the tractor from the seat of the implement being drawn. Harvesting is an operation where more men may be required with a tractor than with horses. It has ordinarily been the case to have one man on the tractor and one on the machine. Often two men are not available, and instead of using the tractor for harvesting it becomes necessary to employ horses. The general purpose tractors are so made that extended controls are not needed for all such operations.

COMFORT AND SAFETY OF OPERATOR.

In choosing a tractor consideration should be given to equipment provided for the comfort and safety of the operator. It should not be overlooked, however, that such conveniences cost money. It is perhaps not generally understood that riding all day on a tractor seat as compared to the seat of some horse-drawn implement is vastly different as regards strain on the driver. There is a constant vibration and jar, which becomes tiring, especially when the operator can not change his position. Many tractors are built with a platform so that one may sit or stand as he desires. When the machine has a furrow-guide or runs with two wheels in the furrow, less attention is required in steering. When working on plowed ground or any loose soil the wheels have a tendency to bring up the fine dirt. Some machines come equipped with fenders which lessen the annoyance and discomfort and add to the safety of the operator. With others, it is possible to purchase fenders as extra equipment.

Some machines have cabs or awnings to keep off the sun. This is especially desirable in hot weather, and will be found a great convenience. It is very easy to improvise a protection of this sort if the tractor is not so equipped when purchased.

The height and position of the drawbar vary on different machines, and in this respect there is greater variation than should exist for tractors of the same size and similar type. More consid-

eration has been given on some machines than on others to this feature. It is comparatively easy with some tractors to hook on an implement, while with others much maneuvering is necessary. A quick release hitch of the spring or break-pin type will be of value in reducing breakage when plowing in stumpy or stony ground.

THE BELT PULLEY.

Particular attention should be given to the size and speed of the belt pulley on the tractor, for it may be such as to make it difficult or almost impossible to use the tractor for some work for which it is supposed to be adapted. The size and speed of the pulleys on driven machines of the same capacity are not always uniform. It is often the case that a tractor apparently lacks power to run certain machines for the operation of which it is supposed to have sufficient power. In an instance of this kind the tractor is usually blamed, while the whole trouble may lie in the relative size of pulleys. The driven machine may lack speed owing to its drive pulley being too large. On the other hand, the drive pulley may be too small, in which case the tractor motor must be run too slowly to deliver its full power. Such an occurrence is likely to occasion loss to the farmer and retard the further purchase of such machines in the community.

When the tractor and driven machine are the product of the same manufacturer they will nearly always work together satisfactorily, but it is not always possible, or even desirable, to buy the tractor and the machinery for use with it from the same manufacturer.

To enable the prospective purchaser and tractor owner to determine the proper size of pulley to use on any driven machine the following formula is given:

$$d = \frac{D \times R. P. M.}{r. p. m.}$$

d = diameter of the machine pulley in inches.

D = diameter of the tractor pulley in inches.

$R. P. M.$ = revolution per minute of tractor pulley.

$r. p. m.$ = revolution per minute of machine pulley.

Given any three of the above-mentioned factors, the fourth can be determined. To illustrate by example: Suppose the tractor is rated at 10-20, has a pulley 18 inches in diameter which travels at the rate of 575 revolutions per minute, and the cylinder of a grain separator to be driven at the rate of 1,200 revolutions per minute. Multiplying the diameter (18 inches) by the revolutions per minute of the tractor pulley (575), the sum of 10,350 is obtained. This sum is divided by the revolutions per minute of the separator pulley (1,200) to find the diameter of the pulley for use to obtain the necessary speed. The result obtained is 8.6, which means that a pulley of 8½ inches is necessary on the separator. Supposing, however, the tractor has a horsepower rating of 10-25, and that the pulley is 18 inches in diameter with a speed of 430 revolutions per minute. Using the same method as before, it is found that a pulley of 6½ inches would be required on the same separator. Again, with a similar tractor having a 14½-inch pulley speeded at 1,050 revolutions per minute, a 12½-inch pulley would be necessary on the same separator.

From the above it will be understood just how important it is to determine in advance just what size of pulley is necessary on any belt machine which it is desired to use with a tractor. The method used in determining the size of pulley to use on the separator is the same for any other belt-driven machine.

FIRST COST.

The initial cost, no doubt, will enter into the choice of the particular make and size of the tractor which a farmer will purchase. The type of machine, make, and size affect the cost, but the one chosen should be the best for the work to be done, soil, topography, and surface conditions. In no case should a farmer allow the first cost of a machine, whether it be low or high, to be the only consideration in his selection and purchase of a tractor. He should never buy a machine of a type and size unsuited to his farm simply because the cost is low. It should be remembered that the lowest-priced machines of good quality are also the smallest and may not be of sufficient power to perform all of the work that should be done on a particular farm.

The value of the extra equipment which the manufacturer puts upon his tractor for the convenience, comfort, and safety of the operator should not be overlooked when a comparison of first cost is made between tractors of the same type and size. The lack of any of this extra equipment may cause an important variation in first cost, but it should be remembered that if a machine is bought which lacks any equipment which will have to be bought later on, the difference most likely will be eliminated.

It should be the object of every prospective purchaser first to determine the size and type of tractor best suited to his farm, and then, if he finds that the purchase of such a machine would be warranted, to select the one of the chosen size and type that will give him the greatest value in material, workmanship, reliability, economy, ease of operation, comfort, and safety for his investment.

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